

Express Mailing Label No. EL487542051US

PATENT APPLICATION  
Docket No. 2729.2.6

**UNITED STATES PATENT APPLICATION**

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**HIGH-SPEED NETWORK OF INDEPENDENTLY LINKED NODES**

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# HIGH-SPEED NETWORK OF INDEPENDENTLY LINKED NODES

## BACKGROUND OF THE INVENTION

### 1. Related Applications

This application is a Continuation-In-Part of and claims priority to U.S. Provisional Patent Application Serial No. 60/134,294, filed on May 14, 1999 and entitled Neighborhood Area Network.

### 2. The Field of the Invention

The present invention relates to computer communications networks. More specifically, the present invention relates to computer high-speed networks linking geographically related users and to manners of implementing and operating such networks.

### 3. The Relevant Technology

Computer technology is breaking barriers to inter-personal communications at an amazing rate. Already, it is possible to communicate almost instantaneously with anyone in the world that has a computer and a telephone line. Computer networks, such as the Internet, link individuals and various types of organizations in world-wide digital communication. The Internet has almost unlimited promise for communications advances, but is limited by an overburdened and somewhat unsuited transmission medium.

In addition to the Internet, businesses, educational institutions, government agencies, and other similarly related entities also communicate over much smaller-scale networks, such as local area networks (LANs) and wide area networks (WANs). These small-scale networks, particularly LANS, operate at much higher speeds than the Internet, but are expensive to operate at large scales. Thus, a large gap exists, between the scope of coverage and speed of operation of the global, but relatively slow, Internet and the faster but more

1 limited LANs and WANs. It would be advantageous to close this gap with larger-scale  
2 networks that operate at speeds close to that of LANS.

3 Several barriers exist to filling the gap between current limited coverage networks and  
4 the Internet. One such barrier is the "last mile" dilemma. That is, the Internet runs at very  
5 high speeds over its backbone, but slows down considerably over its localized connections.  
6 Generally, the Internet relies upon standard telecommunications industry lines and switching  
7 equipment for this last mile. This infrastructure is designed for telephone communications,  
8 and is not well adapted to the packetized communications of digital networks. A dilemma  
9 lies, however, in replacing the telephone infrastructure with transmission mediums more  
10 suited to digital communications. It is currently considered prohibitively expensive to connect  
11 high speed communications lines down to the individual users of the Internet.

12 This fact, together with the general congestion of the Internet in general leads to a  
13 substantial slow down of Internet communications. It also limits the deployment of  
14 intermediate types of networks. A further barrier to the implementation of networks of  
15 varying scopes and to the new introduction of new paradigms for network communication  
16 comes in the form of financing. Such developments using current technology would be  
17 prohibitively expensive. Who is going to pay for this infrastructure?

18 Accordingly, a need exists for an intermediate sized network to close the gap between  
19 the world-wide Internet and current relatively small scale networks. Preferably, such an  
20 intermediate sized network operates at speeds similar to those of LANS, coverage both in  
21 geographical area and diversify of user type. Additionally any solution to this problem should  
22 also address financing of installation and should overcome the last mile dilemma. New  
23 technologies for achieving such a new paradigm in computer networking are similarly needed.

**BRIEF SUMMARY OF THE INVENTION**

In order to overcome many or all of the above-discussed problems, the present invention comprises methods, apparatus, and systems for implementing Large-scale high speed computer network. The network may connect an entire neighborhood or city in networked communications, and accordingly, will be referred to herein as a Neighborhood Area Network (NAN). The NAN of the present invention is a network conducted on a unique scale with a unique clientele and is implemented in a manner that transcends traditional network boundaries and protocols. The NAN is not equivalent to a wide area network WAN, in part because it is essentially routerless. That is, while a plurality of NAN, may be interconnected through the use of routers, each individual NAN is preferably constructed without the use of internal routers. The NAN is unique from local area networks (LANs) as well. One reason is that, due to its many novel features, it can be of a size and scope previously unobtainable by conventional LANs.

The NAN is further unique because it is intended to cover and serve a selected geographical area and to blanket that geographical area, rather than functioning to serve a specific government, business, educational, or similarly related entity. Accordingly, the subscribers and users of the NAN may be substantially non-related in any traditional business manner. Furthermore, funding for the NAN, rather than being provided by a business-type entity or subsidized by a governmental organization, may be funded at least in part by an independent third party, such as a utility company and may be funded in total or in part by subscribers.

The NAN is also comparatively inexpensive to install, making the placement of a NAN in every neighborhood a real possibility. The NAN of the present invention is capable of eliminating the message traffic burden from the Internet, thereby speeding up the Internet, as it is adapted to be operated completely independent of the currently highly burdened telecommunications infrastructure (although Internet service may be provided over the NAN).

1 In one embodiment, the NAN is comprised of an optic fiber ring serving as the outer  
2 backbone of the NAN. The ring is preferably populated with one or more fiber boxes, each  
3 containing circuitry including switches, repeaters, gateways, etc. The fiber boxes in one  
4 embodiment connect the backbone to a central office or headquarters data center in which a  
5 server is preferably located. One or more gateways are preferably provided within the  
6 backbone for access by Internet Service Providers (ISPs). An inner backbone comprised of  
7 scalable 10 to 100 megabit coaxial cable preferably branches from the fiber backbone.

8 The coaxial cable preferably originates at the fiber boxes and branches through the  
9 selected geographical region (discussed herein as a neighborhood, but of course, any  
10 geographical scale could be served), connected by repeaters and nodes to individual  
11 communicating stations. The inner backbone is preferably partitioned for efficient routing of  
12 traffic.

13 The nodes in one embodiment comprise hubs. The repeaters may be placed three  
14 hundred feet apart along the coaxial cable, with hubs placed within thirty feet of every house,  
15 business, or other type of communicating station on the NAN. The hubs preferably connect  
16 to the local houses or other buildings with ten-base-T twisted pair copper wiring employing  
17 the Category 5 (Cat5) standard. The hubs in one embodiment are powered by one or more  
18 of the communicating stations that they service. Accordingly, each station connected to a hub  
19 may share the powering of the hub and may share the powering of other switching equipment  
20 of the NAN as well.

21 In one embodiment NAN software operates on the server, the fiber boxes, the  
22 repeaters, and the hubs. Client software preferably operates a computers located at each  
23 communicating station. Additional functional software or logic may also execute on  
24 communicating stations or computers of subscribing service providers. For example, software  
25 may communicate with an electric power meter for transmitting information regarding power  
26

1 consumption from a communicating station (the power customer) through the network to  
2 third party service provider, in this case, a utility power company.

3 In one embodiment, at least a portion of the backbone is installed over the right-of-  
4 way owned by or franchised to a public utility such as gas, electric, or power company. This  
5 negates any need for a separate utility administering the NAN to acquire a new easement or  
6 franchise from the landowners or the government entity of the geographic region. The NAN  
7 may be financed and/or installed through the cooperation of the utility service provider  
8 company. This arrangement allows the public utility service provider that would otherwise  
9 be unable to enter the digital communication market to participate. It is also advantageous  
10 in that a NAN developer or administration entity would otherwise likely be unable to afford  
11 to finance and install the NAN due to the cost and risk of funding and lack of sufficient  
12 rights-of-way.

13 In certain embodiments of an apparatus and method in accordance with the present  
14 invention, an independent entity may create a city-wide network or NAN. The network  
15 includes, in one embodiment, a fiber optic ring within the city to serve as a local backbone.  
16 The fiber optic ring may be fully redundant. That is, it preferably completes a loop such that  
17 any break in the loop will not shut the whole system down. The fiber can be laid  
18 inexpensively as distances are not great and thus, less expensive local short-distance-types of  
19 fiber cable can be used. A low cost fiber can be used, such as feeder fiber which is less costly,  
20 and which requires less labor to install.

21 The fiber backbone is preferably populated by fiber boxes having switches therein.  
22 Coaxial cable from switches to bridges and repeaters to hubs. The hubs may connect to client  
23 stations using twisted-pair, copper cabling. A central server may be used and may be located  
24 within a headquarters data center. A headquarters data center may be employed as a gateway  
25 for Internet service providers. In addition, the Internet service providers may enter the system  
26 through other gateways including one or more switches.



1 The fiber backbone may be laid using the franchise agreement granted to the power  
2 company within a city or region. Thus, as the entire network is laid independently, the ISP  
3 service is provided independent of the telecommunications line over the entire route.  
4 Additionally, all ISPs are available on the net allowing equal access without choking traffic.

5 The infrastructure is preferably upgradable from 10 megabit to gigabit technology  
6 over the same lines, such that the lines need not be relaid in order to upgrade. Services that  
7 can be provided include surveillance, on-line books, two-way multi camera, schools, etc.  
8 Additionally, IPBX, telephone, television, CATV, and video on demand can be provided over  
9 the NAN. Video can be provided allowing independent selection, broadcast, start time and  
10 may be buffered to the user in real time.

11 The NAN also preferably incorporates one or more multi-port switches which are  
12 configured to truncate broadcast data. The multi-port switch is preferably an indoor switch  
13 but is contained in an aluminum pedestal of dimensions approximately 3 by 2 by 2 feet and  
14 is environmentally controlled.

15 The repeaters in preferred embodiments convert the data from the switches to be  
16 transmitted over coaxial cable and are preferably semi-intelligent. In one embodiment, the  
17 repeaters are housed out of doors within a protective pedestal. The pedestal may be located  
18 on the ground or hung from power lines.

19 The bridges are, in preferred embodiments, high speed with a look-up binary tree and  
20 are preferably contained in the protective pedestals. The bridges also filter out broadcast  
21 traffic. The hubs route traffic to subscribing communicating stations and convert from coaxial  
22 to twisted pair cable. The hubs are connected with a T-connector and powered by the  
23 cooperative power coupler of the present invention.

24 The P-coupler preferably includes a series of transformers, one at each communicating  
25 station. The communicating station connect with Cat5 wiring to the hub through a home  
26 connection box. The home connection box preferably provides convenient connections for

1 power to the hub and for transmit and receive lines. The lines at the home connection box  
2 are wired alphabetically. The home connection box connects preferably connects with  
3 Ethernet cabling to a network card located within a computer at the client station.

4 A modular power connector is preferably located at the home connection box. The  
5 wiring from the communicating station to the hub operates, in one embodiment, at ten  
6 megabytes per second. Three pairs of lines are preferably used, a transmit twisted pair, a  
7 receive twisted pair, and an A/C twisted pair running from the transformer to power the hub.

8 The NAN of the present invention is a high speed routerless network which differs  
9 from traditional large scale networks in that traffic is routed locally and that it has the speed  
10 of a small local area network but with many more stations connected thereto. The large  
11 amount of communicating stations is facilitated by the many novel aspects of the invention.

12 The NAN can be described as a baseband network rather than a broadband network  
13 because it addresses communicating stations directly and linearly rather than through  
14 broadcasting of data. The NAN of the present invention defines what cannot be routed rather  
15 than defining the types of packets that can be routed. The NAN also preferably uses  
16 converse/inverse filtering. Because the communications traffic is direct-routed, neighbor to  
17 neighbor communications is very high speed and occupies only a small part of the NAN. It  
18 also reduces the burden on the Internet.

## 19 20 METHOD OF IMPLEMENTATION

21 The NAN of the present invention is unique in that its clients are merely  
22 geographically related, rather than being business, government, educational institution, or  
23 otherwise related. Additionally, individual subscribers pay for the continued operation of the  
24 NAN rather than a single large entity. The NAN may be partially funded by public service  
25 companies such as utility companies. In one embodiment, the power company pays a portion  
26 of the installation fees in return for receiving a portion of the subscription and allows the



1 infrastructure to be installed along its rights of way for which it has a business franchise.

2 Accordingly, the NAN need not have a separate franchise and need not be a public utility.

3       Additionally, the power company or other public utility may receive benefits in the  
4 form of cheaper monitoring of the usage of its services. For instance, power companies may  
5 be able to automatically read the meters of the subscribers through the NAN, rather than  
6 having to send out meter readers, thereby reducing the cost. Billing and payment may also  
7 be automated over the NAN, further reducing costs.

8       The NAN may be administered by a private company, but is preferably not controlled  
9 by any central agency, governmental body or other entity, and thus, is a true community  
10 network.

11       Subscribers are allowed to join for an initial hook-up fee and a monthly service fee,  
12 similar to cable or telephone service. Upon paying the hook-up fee, customers are connected  
13 and provided with access to the NAN, but if they do not pay the monthly fee, some or all their  
14 services may be cut off.

15       The subscribers are all provided with an IP address upon the first use of their account.  
16 The IP address is in one embodiment semi-permanent in that it is retained until the subscriber  
17 changes network cards or computers. The IP addresses are retained in a binding within a  
18 server located at the central office. The server sends out the IP addresses, and the IP  
19 addresses are retained within bridges and within the switches in order to route the traffic  
20 accordingly.

21       The subscribers are preferably provided with Internet service from outside ISP which  
22 connect to the backbone through gateways. Internet service fees may be part of the  
23 subscription or may be part of independent subscription fees.

24       These and other objects, features, and advantages of the present invention will become  
25 more fully apparent from the following description and appended claims, or may be learned  
26 by the practice of the invention as set forth hereinafter.

**BRIEF DESCRIPTION OF THE DRAWINGS**

In order that the manner in which the above-recited and other advantages and objects of the invention are obtained will be readily understood, a more particular description of the invention briefly described above will be rendered by reference to specific embodiments thereof which are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments of the invention and are not therefore to be considered to be limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

Figure 1 is a schematic block diagram illustrating one embodiment of network system hardware for use with the present invention.

Figure 2 is a schematic block diagram illustrating one embodiment of a system architecture for use with the present invention.

Figure 3 is a schematic block diagram of one embodiment of a network architecture for use with the present invention.

Figure 4 is a schematic block diagram of one embodiment of a traffic filter module for use with the present invention.

Figure 4A is a schematic representation of one embodiment of a communications packet of the present invention.

Figure 4B is a schematic representation of an OSI seven layer model.

Figure 5 is a schematic representation of a manner of connecting a communicating station to a communications node of the present invention.

Figure 6 is a perspective view of a connection box of the present invention.

Figure 7 is a partially exploded perspective view of a pedestal of the present invention.

Figure 8 is a perspective view of a hanging pedestal of the present invention.

Figure 9 is a schematic flow chart diagram listing steps of a method of operating a NAN of the present invention.

1           Figures 10 through 15 are a schematic flow chart diagrams describing in greater detail  
2 steps that may be conducted in accordance with the method of Figure 9.  
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## **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

Referring now to Figure 1, shown therein is a schematic block diagram showing various hardware components of one embodiment of a large-scale, high speed network of the present invention. Because the network is intended to serve a selected geographical region, it is referred to herein as a neighborhood area network (ANA) 10. The NAN 10, as depicted, includes a backbone 12, that is divided into two components. A first component is a fiber backbone 14 that is preferably adapted to transmit packetized data using standard optical communications protocols and technology. The fiber backbone 14 is preferably configured in a ring with incoming traffic traveling in a selected given direction.

A second component comprises a local backbone 16 that is preferably configured with a non-redundant branching structure and that is adapted to transmit data using radio wave signals. In the schematic depiction of Figure 1, the physical locations of connections are represented, while an example of the actual branching structure is shown in Figure 3.

The NAN system 10 in the depicted embodiment of Figure 1 also includes a server 18 which may be located at a central headquarters office 20. One or more fiber switches 22 may be located within the fiber backbone 14. Indeed, the fiber backbone 14 may complete a circle around a neighborhood or other common geographical region which is intended to be networked in computer, voice, and or/video communication. The fiber backbone 14 may be provided with redundant loops in case one loop becomes inoperable.

The local backbone 16 preferably communicates with the fiber backbone 14 through one or more fiber switches 22. Each fiber switch 22 is preferably configured to examine packetized message traffic passing therethrough, and where a message is intended for a communicating station serviced by a portion of the local backbone serviced by the switch 22, route the message onto the local backbone 16. Each switch 22 also preferably routes locally generated traffic with external destinations to the fiber backbone 14 for receipt by other

1 switches or gateways 108 to the Internet 34. The switches 22 preferably also convert  
2 communications between optical communications signals and radio frequency signals.

3 Within the local backbone 16, switching devices, including a series of repeaters 24,  
4 nodes 26, and bridges 50 are preferably deployed. In one embodiment, the local backbone  
5 16 is provided with coaxial cable 38 having a sufficiently high band width and having signals  
6 of sufficiently high amplitude that repeaters 24 are needed only every 300 feet or so. The  
7 nodes may comprise hubs 26 which, due to the efficient propagation of the NAN 10, can be  
8 located up to 30 feet from each communicating station 30.

9 Communicating stations 30 in one embodiment connected to the nodes 26, with Cat  
10 5, twisted pair wiring 40 through a home connection box 42. Internet Service Providers  
11 (ISPs) 32 are shown connected to the NAN 10 through in several different types of gateways.  
12 An ISP 32 may connect through the central headquarters office 20 and from there to a fiber  
13 switch 22. Alternatively, an ISP may communicate directly with the fiber backbone 14  
14 through a fiber switch 22. The ISPs provide access to the worldwide web and the Internet  
15 34.

16 Each communicating station 30 may be provided with one or more home service  
17 boxes 44. The service boxes 44 communicate over the NAN 10 and provide interactivity  
18 from a remote distance. The service boxes 44 may comprise, for instance, power meters 46,  
19 security systems 48, and any number of electrical and mechanized devices, including  
20 appliances, sprinkling systems, synchronized clocks, etc.

21 The fiber switches 22 may be housed within containment units 52. The containment  
22 units 52 may be located inside or out of doors and are preferably provided with insulation  
23 and/or environmental control devices such as a fan 54 and/or air conditioning 56. The  
24 containment units 52 are preferably vented.

25 The repeaters 24, bridges 50 and nodes 26 are preferably located within protective  
26 pedestals 28 which are also preferably vented, which provide a hardened outer shell, and

1 which may be provided with fans 54 or other environmental control devices. The pedestals  
2 28 may be mounted in the ground, or may be mounted from utility and/or power lines  
3 overhead. The pedestals 28 preferably provide some type of lightening protection such as a  
4 Faraday shield. The pedestals 28 are described in greater detail below with reference to  
5 Figures 7 and 8.

6 Figure 2 is a functional block diagram illustrating a system architecture 100 including  
7 operative data structures and executable modules for controlling the operation of the  
8 hardware of the NAN 10 depicted in Figure 1. The system architecture 100 controls the  
9 interactions of the various intelligent components of the NAN 10 of Figure 1.

10 Accordingly, shown in Figure 2 are the different modules and executables for  
11 operating the NAN 10. Included are a plurality of client stations 30 communicating over a  
12 transmission system 102. Other entities may also communicate over the transmission system  
13 102. These include the central headquarters office 20, the server 18, a monitoring station  
14 152, and service providers 104, including a utility company 106.

15 Referring now to the transmission system 102, one method of operation of the NAN  
16 10 to transmit information between the client stations 30 will be described. In one  
17 embodiment, the NAN backbone 12 is essentially routerless. That is, the system is operated  
18 at a large scale, but using the same principles as a small local area network. This is achievable  
19 due to the unique architecture and configuration of the NAN 10. Routers (62 in Figure 3)  
20 are required only when connecting to outside entities, such as other NANs or the Internet 34.

21 Components included within the system 100 include the bridges 50, the switches 22,  
22 the repeaters 24, and the nodes, which in one embodiment comprise hubs 26. Also included  
23 within the system 102 is an Internet routing module 108 which routes traffic to and from the  
24 ISP's 32. The Internet routing module 108 operates as a gateway and may comprise a switch  
25 22 and a router 62.

26



1 The switches 22 are provided with software modules in the form of a switch routing  
2 module 110 and a switch conversion module 112. The switch routing module 110 is used to  
3 route traffic between the switches 22. The switch conversion module 112 is used to convert  
4 packeted traffic between the optical communications protocol and the radio frequency signals  
5 used within the coaxial cable lines 16. Thus, in preferred embodiments, each switch includes  
6 one or more protocol converters interfacing between fiber cabling and Cat5 twisted pair  
7 wiring.

8 The protocol converters translate the optical signals into radio frequency signals for  
9 transmission on the coaxial Cat5 cables. The radio frequency signals are in turn translated  
10 into digital signals by the network cards 156.

11 The Cat5 twisted pair wires lead into out of the switch 22 and connect to the protocol  
12 converters 112 and to repeaters 24. The repeaters 24 place the data packets on the coaxial  
13 cable 16. The Cat5 wiring may also lead directly to client stations 30 that are within 300 feet  
14 of the switch 22.

15 Traffic is routed in an efficient manner whereby the system 100 utilizes the high speed  
16 fiber cables 14 to as great a degree as possible routing packetized traffic to the switch 22  
17 closest to the communicating station 30 to which the message is addressed. Once the packet  
18 reaches the closest switch 22, it is routed through a repeater 24 onto the local backbone 12.  
19 Once on the local backbone 12, the packet passes to a bridge 50 and then to the node 26  
20 closest to the client station 30 in a manner be discussed below with relation to Figure 3.

21 The repeaters 24 are preferably spaced approximately every 300 feet in order to avoid  
22 over-attenuation of the signals carrying the data packets. The nodes 26 are placed within 30  
23 feet of each communicating station 30.

24 The communicating stations 30 are preferably provided with client software 126 for  
25 enabling communications over the NAN 10. The NAN 10 communications medium is, in one  
26 embodiment, standardized Ethernet data packets adhering to the Ethernet/OSI standards. In

1 one embodiment, the data packets may be transmitted over the NAN 10 using merely MAC  
2 addresses of the low levels of the OSI model.

3 Client stations 30 which are new to the NAN 10 transmit an initial communication  
4 packet over the NAN 10 to the server 18. The server 18 in reply issues an IP address 138 to  
5 the client station 30 which is semi-permanent. Thereafter, the client station 30 has a semi-  
6 permanent IP address 136 which is changed only upon incidents such as the computer or  
7 network card of the client station 30 being changed.

8 The packets are routed through the switches 22, repeaters 24, and nodes 26, to the  
9 addressed client stations 30. The packets may be transmitted at a rate of 10 megabits per  
10 second due to the unique architecture of the NAN 10. This high rate of speed can be  
11 upgraded by a factor of 10 or even up to a factor of one hundred without having to redeploy  
12 the fiber cables 14, the coaxial cables 16, and the pair twisted wiring 40. This, again, is due  
13 to the unique architecture of the system.

14 The system architecture includes extending the distance a packet can travel up to  
15 between 3000 and 25000 feet and increasing the maximum tolerable packet acknowledgment  
16 time. This is accomplished in one embodiment by digressing from the IEEE standards.

17 For instance, the signals with which the packets are transmitted are amplified to a  
18 higher power than those on standard networks. This is accomplished by increasing the gain  
19 in the amplifiers that make the repeaters function. Additionally, the reception equipment is  
20 preferably more sensitive and able to capture a more degraded signal than standard network  
21 equipment.

22 The fact that the system operates on a baseband concept wherein all of the cable  
23 bandwidth is restricted to one channel rather than being divided into multiple channels allows  
24 for a higher bandwidth and greater power from the repeaters. This allows for collision  
25 detection over the cable 38 and for a release of the collision detection at a much lower level.  
26 Thus, voltage spikes are detected and ignored so that lower level collisions are not detected

1 and the large level collisions can be detected. The incidences of these collisions are highly  
2 reduced due to the high bandwidth and direct routing of the system 100.

3 Collision detection is preferably accomplished through voltage detection and timed  
4 resends and is adjusted to compensate for the increased sensitivity of the repeaters.

5 The repeaters 24 are provided with software or other logical circuitry 120 therein  
6 which allows the repeaters 24 to be semi-intelligent. The repeaters 24 transmit the fact that  
7 they are functioning, as well as information regarding the amount of traffic passing  
8 therethrough, in order to better manage the NAN 10. Otherwise, the repeaters 24 merely  
9 pass the packets through and do not provide any switching function, merely increasing the  
10 amplitude of the signals carrying the packets. As mentioned, the repeaters 24 are, in one  
11 embodiment, placed every 300 feet across the local backbone 16.

12 The hubs 26 route the packetized traffic through the Cat5 twisted pair wiring 38 to  
13 the communicating stations 30. Internet routing 108 may also take place to route the Internet  
14 communications to the ISPs 32. Communications with external stations over the Internet 34  
15 may be conducted with a permanent IP address to get the messages within the NAN 10,  
16 wherein the outside data packets are routed using MAC addresses. Additionally, stations 30  
17 without permanent IP addresses may communicate through the use of a masqueraded IP  
18 address using a permanent IP address to get into the NAN and the semi-permanent IP  
19 addresses 136 issued to each client station 30 in a manner that will be discussed below in  
20 greater detail.

21 The bridges 50 are provided with software 114 and are also provided with a memory  
22 116 containing a bank 118 of the IP addresses 136 of each client station 30. The bank 118  
23 also includes, for each corresponding IP address 136, information regarding the location of  
24 the client station 30 to which the IP address 136 is assigned.

25 Accordingly, the bridges limit communications to only a particular portion of the  
26 network 10 to which the communication is addressed. Thus, the bridges 50 effectively

1 partition the NAN 10. A further function of the bridges 50 and the switches 22 is to eliminate  
2 unwanted communications. For instance, in one embodiment, broadcast packets and  
3 messages are forbidden. Accordingly, each switch 22 and bridge 50 may be provided with  
4 a traffic filter module 160 as depicted in Figure 4.

5 Referring to Figure 4, the traffic filter module 160 is used to eliminate certain types  
6 of traffic that may not be routed over the NAN 10. Accordingly, the NAN 10 is defined as  
7 determining what types of communications can not be routed rather than determining what  
8 types can be routed, as in the prior art. Within each traffic filter module 160 may be a  
9 broadcast traffic sniffing module 162. The broadcast traffic sniffing module 162 examines  
10 each information packet 165 (shown in Figure 4A) and checks certain fields 171 which  
11 indicate that the packet 165 is broadcast data. When the traffic sniffing module 162  
12 determines that the packet 165 is broadcast traffic, it then initiates the traffic elimination  
13 module 164 which eliminates the broadcast packet 165.

14 The bridges 50 and switches 22 in one embodiment detect broadcast traffic by  
15 detecting an empty field 171 within the MAC address 170. Alternatively, the broadcast traffic  
16 sniffing module 162 may detect a series of addresses at a certain level such as 255, 255, 255,  
17 255 to detect a broadcast packet 165.

18 Thus, because the NAN 10 eliminates unwanted traffic and restricts traffic to only  
19 those portions of the NAN 10 through which the packet 165 must travel to reach the  
20 addressed communication station 30 in the most efficient manner, much extraneous traffic is  
21 eliminated. This, combined with the higher speeds of the present invention, allow the NAN  
22 10 to be operated as if it were a local area network but on much grander scales, indeed, even  
23 to include entire neighborhoods or municipalities. Additionally, because of this, the NAN 10  
24 is suitable for use in geographical areas covering extensive distances that are merely  
25 geographically or community interest related, rather than being business, government,  
26

1 education or otherwise related. Thus, the NAN system 10 can be by financed at least in part  
2 by the service providers which will benefit from the efficient communication of the NAN 10.

3 Referring now to the service providers 104 of Figure 2, an example of such a service  
4 provider is a utility company 106. In one embodiment, the utility company 106 is a power  
5 company. Thus, for example, the power company can communicate over the transmission  
6 system 102 on the NAN 10 with each client station 30. Within each client station 30 is one  
7 or more service boxes 144 having therein customer service software 150.

8 The customer service software 150 might, in one instance, comprise power meter  
9 software 148 within a power meter box 46. The power meter software 148 may transmit  
10 power usage through the NAN 10 back to the utility company 106. The utility company 106,  
11 with a power usage collection module 144, receives the power usage data and transmits it to  
12 a billing module 146. The billing module 146 then bills the customer at the communicating  
13 station 30 over the transmission station 102. The payment of the bill may also pass through  
14 the transmission system 102, thus passing through the NAN 10 back to the utility company  
15 106. Of course, utility companies other than the power company may also use this system  
16 of data collection billing and payment receipt.

17 Other types of service boxes 144 may also contain customer service box software 150.  
18 For instance, the security system 48 may contain therein software which notifies the  
19 monitoring station 152 of any irregularities. Software 154 within the monitoring station 152  
20 may monitor the data transmitted by the security system 48. For instance, this data might  
21 include home security system data indicating that a break-in has occurred. The security  
22 system 48 may also indicate the occurrence of a fire, and may transmit full video surveillance  
23 data back to the monitoring station 152. The monitoring station 152 or a similar station may  
24 also monitor the contents of the NAN 10 in order to eliminate illegal traffic. Pornography or  
25 other types of traffic may likewise be eliminated.

26



1 Each client station 30 as mentioned, preferably communicates at the MAC layer within  
2 the NAN 10. The client stations 30 may also be provided with a semi-permanent IP address  
3 for communications external to the NAN 10. The server 18 is provided with server software  
4 124 which maintains a bank 138 of the IP addresses 136. The server 18 thus issues the IP  
5 addresses 136 and also maintains a binding between the MAC layer communications and the  
6 IP addresses 136. These bindings are transmitted to the switches 22, bridges 50, and any  
7 other equipment with a need to know the IP addresses 136 of the client stations 30.

8 Consequently, the server 18 is not necessary other than for issuing IP addresses and  
9 maintaining bindings, and indeed, if the server 18 were to go down, the transmission system  
10 102 operating on the NAN 10 could continue to operate. New client stations 30 would  
11 merely not be able to receive an IP address.

12 The central headquarters office 20 preferably contains therein a headquarters software  
13 module 128. The headquarters software module 128 may conduct monitoring and billing  
14 types of operations. Thus, a customer database 130 may be maintained therein and may  
15 coordinate with a billing module 134. A redundant database 132 is also preferably included.  
16 The redundant database 132 may be located at a distant site such that it maintains a copy of  
17 all data in the case of a failure of the customer data 130. Synchronizing information may  
18 pass between the customer database 130 and the redundant database 132 over the NAN 10  
19 with the use of the transmission system 102.

20 Billing information may be generated and stored within the billing module 134 and  
21 may be transmitted to communicating stations 30 over the transmission system 102. The  
22 customer database 130 may maintain records including records of which customers are behind  
23 on their payments. If the customers are behind, the client station 130 of that customer may  
24 be denied services in part or in full of the NAN system 10. These services include, in one  
25 embodiment, Internet service.

26



1 The communicating stations 30 are preferably provided with standard network cards  
2 156 which transmit through the home connection box 42. The client software 126 residing  
3 at the communicating stations 30 preferably maintains the client's IP address 136 and receives  
4 and generates data packets (shown at 165 in Figure 4A) with which information is transmitted  
5 over the transmission system 102. The client software 126 may provide many various types  
6 of functions, including video phone communication, audio, and video transmission, payment  
7 of bills, ordering of on-demand video, transmission of home security information, etc.

8 A power coupler 135 may be provided within or in communication with the home  
9 connection box 42. The power coupler 135 preferably conditions incoming power from a  
10 power source at each communicating station, combines the power and network connection,  
11 and provides a simple manner of connecting the twisted pair wiring to standard computer  
12 cabling, preferably Ethernet cable, which passes to the computer at the communicating station  
13 30. In one embodiment, the twisted pair wiring is provided with a twisted pair for  
14 transmission, a twisted pair for reception, and a twisted pair carrying AC to the hub 26, as  
15 will be discussed in greater detail below with reference to Figures 5 and 6.

16 The hub 26 is in one embodiment provided with a power concentrator 25 which  
17 provides power conditioning and power delivery to the hub 26. The power concentrator  
18 receives power from the power coupler 135 of the communicating stations 30. Preferably the  
19 power concentrator 25 receives power from two or more stations 30 and passes the power  
20 on to the hub 26 or other switching device. A Power concentrator 25 receives power through  
21 a transformer connected to a wall socket at the communicating station 30. In one preferred  
22 embodiment, four houses share a hub and provide power to the hub. The hub bleeds power  
23 out of the four transformers at a time, but can receive power from less than all of them and  
24 be at a full power level. This redundant power supply scheme ensures that the hub 26  
25 continues operating even if one of the power sources, i.e., one of the communicating station  
26 30, goes down. Thus, AC power is received from the communicating station 30 through the

1 power coupler 135 to the power concentrator 25. In addition, all switching equipment may  
2 be powered cooperatively in this manner and may be provided with power concentrators 25.

3 In one embodiment, the AC power is received directly from a power meter (seen at  
4 46 in Figure 5) at the communicating station 30. The power from the communicating stations  
5 30 may be provided individually or collectively to the switches, bridges, repeaters, router,  
6 hubs, and any other switching equipment of the NAN. Additionally, power meters not  
7 located at communicating stations 30 may be utilized to provide power to the hubs 26 and  
8 other switching equipment.

9 In one embodiment, the communicating stations 30 or the hubs 26 comprise a power  
10 meter monitoring hub 26. The power meter monitoring hub 26 may comprise an RF receiver  
11 and an 8-bit microcontroller as well as an RS 232 communications interface and a power  
12 supply. The hub may also contain up to four 10-base T ports. On-site configuration is  
13 provided by an RS 232 port. Under this embodiment, the monitoring hub receives power  
14 consumption data from power meter transmitters and passes it on to the utility company 106  
15 over the transmission system 102.

16 Each power meter 46 in this embodiment provided with a power monitoring  
17 transmitter. The transmitter may be comprised of a PIC microcontroller, a 418 megahertz  
18 UHF transmitter, a photo-reflective sensor, and an off-line power supply. The transmitter  
19 may use the photo-reflective sensor to monitor rotation of the power meter disk and store the  
20 information in nonvolatile memory in the microcontroller. The transmitter transmits the  
21 power usage information to the power meter monitoring hub along a 418 megahertz RF link.

22 In one embodiment, the coaxial cable, as well as the 10-base T wire, is housed within  
23 a protective conduit. The system may operate with Linux using an IP chain and masquerading  
24 which is considered more effective than using a proxy server.

25 The bridges 50, in addition to eliminating broadcast traffic, may also receive and  
26 regenerate the packets 165 at a higher power level. The repeaters 24 preferably merely

1 amplify the signals carrying the packets 165 and do so without any delay, while the bridges  
2 may slow down the packets somewhat.

3 Referring now to Fig. 3, shown therein is a functional block diagram of a NAN  
4 hierarchy scheme 60. Within the scheme 60 is shown the fiber backbone 14 looping in a  
5 circuitous manner to form a ring. Within the fiber backbone 14 is a plurality of switches 22.  
6 A central switch 22a is shown connected with the central headquarters 20 and through a  
7 router 62 to the Internet. Thus, the fiber backbone 14 comprises an outer circuitous  
8 backbone. It should be noted that the NAN 10 may have a plurality of gateways 62. Because  
9 of the plurality of gateways, any number of ISP providers 32 may provide service to the NAN  
10 10. Other types of service providers and outside entities may also access the NAN 10  
11 through the gateways 62.

12 Emanating from the switches 22 are components of the local backbone 16 which are  
13 arranged in a branched configuration. Thus, shown branching out from each switch 22 is a  
14 series of bridges 50, repeaters 24, and hubs 26. Each bridge 50 separates and services a  
15 plurality of hubs 26.

16 Thus, an incoming packet 165 received, for instance over the Internet 34, passes  
17 through the router 62. The router 62 uses an IP address 169 shown in Fig. 4a to determine  
18 that the packet is local to the NAN 10. For instance, the IP address may be assigned to the  
19 NAN 10 or to the router 62 specifically under a masquerade scheme that will be described.

20 Once the packet 165 reaches the NAN 10, it is routed using a MAC address 170 of  
21 Fig. 4a. After passing through the router 62, the packet 165 is received by the central switch  
22 22a. As shown in Fig. 4A, the packet 165 comprises a header 166, a data portion 167, and  
23 a footer 168. The header comprises the address of the addressed communicating station 30...  
24 The footer contains redundancy information to make sure the packet 165 was properly  
25 received. A cyclical redundancy check (CRC) may be used using information in the footer  
26 for acknowledgment that the packet 165 was received and has not been degraded.

1           Within the header 166 may be both an IP address 169 and a MAC address 170. The  
2           MAC address 170 refers to a unique number given to each network card 156 of Figs. 2 and  
3           5. The IP addresses 169 are administered by the Internic agency and are addresses utilized  
4           under the TCP/IP protocol. Each station has a unique MAC address. Additionally, each  
5           station may have a unique IP address 169.

6           Nevertheless, because IP addresses 169 are becoming scarce and difficult to procure,  
7           a masqueraded system may be employed wherein the router 62 contains a routable IP address  
8           or several routable IP addresses and stations 30 within the NAN 10 are addressed by the  
9           routable IP address of the router 62 outside the NAN 10. Once addresses containing the  
10          masqueraded IP address reach the NAN 10 at the switch 22a, the MAC address 170 may then  
11          be used to route the packet 165 within the NAN 10. Indeed, within the NAN 10, routing is  
12          preferably exclusively conducted using the MAC address 170.

13          When communicating on the MAC level, a communicating station 30, in one  
14          embodiment, uses a protocol such as an ARP request. The "ARP" request is an address  
15          resolution protocol. The ARP protocol talks to the network cards looking for the MAC  
16          address. The use of an ARP-type address protocol by the NAN 10 does not adhere exactly  
17          to the ARP address protocol but is similar to it.

18          Thus, the server 18 may be characterized as a modified DHCP server but does not  
19          broadcast DHCP as with the prior art systems, though it does maintain the IP-MAC address  
20          binding and notifies all subscribing components of that binding. Under this arrangement,  
21          when a communicating station 30 comes on-line and receives the non-routable IP address  
22          from the server 18, it then binds the IP address. In one embodiment, this is done by  
23          populating its registry with the IP address. That is, the IP address is bound to the TCP/IP  
24          protocol stack. This IP address is used for TCP/IP protocol communications with stations  
25          72 external to the NAN 10. As discussed, all internal communications are preferably routed  
26          using the MAC address.

1           Of course, the communicating stations 30 could also receive permanent IP addresses  
2 either from the server 18 or directly from Internic. These permanent, routable IP addresses  
3 may also be maintained within the binding of the server 18.

4           Preferably, hubs, bridges and switches work on only the lower two levels of the OSI  
5 model of Fig. 4b. When a packet 165 is addressed to go outside of the NAN-10, it is sent to  
6 the router 62 which acts as a gateway to the Internet 34 and passes the packet 165 outside  
7 the NAN 10. The IP addresses within the communicating stations 30 communicate through  
8 virtual ports on the communicating stations 30 but preferably not through the same  
9 communicating ports as traditional DHCP protocol standards.

10           Additionally, the IP addresses are semi-permanent. That is, the communicating  
11 stations 30 maintain a single IP address for external communications and do not flood the  
12 NAN 10 with requests for DHCP servers to receive IP addresses from. Indeed, because of  
13 this substantially, only direct routed traffic exists on the neighborhood, and all broadcast  
14 traffic is substantially squelched. Additionally, all traffic is partitioned within its own area and  
15 does not travel across the entire network. For this reason, there are substantially less  
16 collisions because traffic is much more localized. This also allows the network to service  
17 many more communicating stations 30.

18           The OSI model 190 is shown in Fig. 4b. As shown therein, the OSI model comprises  
19 a first layer 191 known as the physical layer. A second layer 192 is known as the data link  
20 layer and it is this layer that predominantly deals with the MAC address 170. A third layer  
21 193 is referred to as the network layer, a fourth layer 194 is referred to as a transport layer,  
22 and a fifth layer 195 is referred to as a session layer. The session layer 195 primarily deals  
23 with the IP address 169. A sixth layer 196 is referred to as the presentation layer, and a  
24 seventh layer 197 is referred to as the application layer. Within the seven layer OSI model,  
25 the upper levels allow two communicating stations, one assigned as a client and one assigned  
26 as a server, to coordinate communications with each other.



1 Referring back to Fig. 3, once message traffic 165 is received from the router 62 to  
2 the switch 22a, the switch 22a maintains the packet 165 momentarily in a buffer 164 and  
3 refers to a database 66 to determine whether the MAC address 170 is local to a partition 169  
4 belonging to the switch 22a. Switch 22a makes this binary determination, and if the answer  
5 is yes, passes the packet 165 to a first bridge 50a.

6 If the answer is no, that is, the traffic is not local to a partition 168, the switch passes  
7 the packet 165 in a given direction to a subsequent switch 22. In the depicted embodiment,  
8 the given direction is clockwise. Upon passing the packet 165 on, a subsequent switch 22  
9 receives the packet 165 and similarly examines the packet 165 to determine whether it is local  
10 or external to a partition 168. If the packet is local to the partition 168, the switch 22 will  
11 pass it on to a bridge 50 within a partition 168 to which the switch 22 belongs. If the packet  
12 165 is addressed external to the partition 168 of the switch 22, the switch 22 passes the  
13 packet 165 in the given (clockwise) direction to a subsequent switch 22.

14 Presuming that the packet 165 was local to switch 22a, switch 22a passes the packet  
15 to a first bridge 50a. The bridge 50a then holds the packet 165 temporarily in a buffer 64 and  
16 refers to a local database 66 to determine whether the packet 165 is local or external to the  
17 bridge 50a. If the packet 165 is local to the bridge 50a, the bridge 50a determines which of  
18 the hubs 26 connected with the bridge 50a the packet 165 must be routed through.

19 If the packet 165 is addressed external to the bridge 50a, the bridge 50a passes it to  
20 a subsequent bridge 50b. The bridge 50b then receives the packet 165 within a buffer 64 and  
21 examines its database 66 to determine if it the packet is addressed to a local station 30. If it  
22 is not, it passes it on to subsequent bridges 50 (not shown) in the branching structure of the  
23 local backbone 16.

24 The bridges 50 are typically separated by one or more repeaters 24 to amplify the  
25 radio frequency (RF) signals which contain the packets 165. Referring now back to bridge  
26 50a, if the packet 165 was local to bridge 50a, it determines which of the hubs 26 to pass it



1 to. Presuming that the packet 165 was addressed to a station 30a within a hub 26a, the bridge  
2 passes the packet to the hub 26a. The hub 26a briefly maintains the packet 165 within a  
3 buffer 64 and examines its database 66 to determine which of the subscribing communicating  
4 stations 30 the packet 165 belongs to. In this case, it determines that the packet belongs to  
5 station 30a and places the packet on a line 40 to be received by a network card 156 located  
6 at the communicating station 30a. A similar process would occur with every bridge 50.  
7 Thus, for instance, if the packet were addressed to a station 30b, the bridge 50b would  
8 receive the packet and transmit to the hub 26b, which would receive the packet 165 and  
9 transmit it to the communicating station 30b.

10 Inter-NAN communications are even more simplified. For instance, if the  
11 communicating station 30a wishes to communicate with the communicating station 30b, client  
12 software 126 would prepare the packet 165 and place it through the network card 156 onto  
13 the NAN 10. The packet 165 would be received by hub 26a which would in turn transmit the  
14 packet 165 to the bridge 50a. The bridge 50a would examine the packet once again to  
15 determine whether it is local or external to the bridge 50a. If it is locally addressed, the bridge  
16 50a transmits to the appropriate hub 26 connected thereto. If it is not, it directs the packet  
17 165 to another bridge 50 or to the switch 22a, depending on the MAC address 170.

18 The switching equipment, such as the switches, bridges, and hubs, preferably use a  
19 binary tree sorting algorithm to sort through addresses in the attendant databases 66 to  
20 determine the location of stations 30 addressed by the packets 165, which greatly enhances  
21 the speed thereof. The binary tree, rather than being just a one dimensional look-up table or  
22 bubble sort, is branched and allows for larger databases without significant propagation  
23 delays. The binary tree is implemented, in one embodiment, using the Nikolas Wirth style that  
24 is known in the art.

25 Note that each bridge 50 also preferably contains its own sub-partition 70 in the  
26 partition 68 of the switch 22 to which it subscribes. In this case, when a bridge, such as

1 bridge 50 determines that the packet 165 is local to the partition 68 but not within its own  
2 subscribing hubs 26, the bridge 50a passes the packet 165 on to the bridge, e.g. bridge 50b.  
3 The bridge 50b then examines the packet 165 and determines that it belongs to the hub 26b  
4 and passes it on to hub 26b. Hub 26b in turn examines the packet 165 and passes it on to the  
5 communicating station 30b.

6 If a communicating station 30 such as the station 30a wants to communicate with a  
7 computer or entity 72 outside of the NAN 10, it addresses the packet 165 using the IP  
8 address 169 of the entity 72. If the outside station 72 wishes to communicate with the station  
9 30a, it also uses an IP address 169 to get into the NAN. This IP address 169 may be either  
10 a permanent IP address received from the Internic agency or a masqueraded IP address  
11 attributable to the router 62. The outside station 72 sends any return messages using this IP  
12 address.

13 If the masqueraded IP address is used, the router 62 passes the packet 165 to the  
14 switch 22a, which then examines the MAC address 170 without having to refer to the IP  
15 address. Thus, one difference between bridges 50 and the routers 62 of the present invention  
16 is that a bridge 50 reads only at the MAC level while a router 62 reads at the IP level.

17 The outside station 72 could also be part of a NAN other than the NAN-10. The  
18 outside station 72 could communicate using MAC addresses to other outside stations 72  
19 within its own NAN, but once it wished to communicate with an entity outside its own NAN  
20 such as the communicating station 30a, it then must use an IP address to pass packets 165  
21 through the Internet with the use of routers 62.

22 As presently contemplated, each NAN 10 may have 10,000 or more communicating  
23 stations 30. A community having more than 10,000 locations wanting to subscribe to the  
24 NAN 10 would require more than one NAN 10. Additionally, under the present system, this  
25 maximum number may be increased by increasing the speed of the local backbone 16. The  
26 speed of the local backbone may be increased up to, for instance, a gigabit per second of

1 throughput without having to reinstall the communicating lines. To increase the number of  
2 subscribing communicating stations 30 within a NAN-10, the firmware constituting the  
3 software within the client stations server, hubs, bridges and switches are replaced, in an  
4 operation that is substantially transparent to the communicating stations 30.

5 Stations within the different NANs preferably communicate with each other over the  
6 Internet, as discussed. Nevertheless, within each NAN communications are routerless in the  
7 preferred embodiment.

8 Presently, the standard for communications on the inner backbone 16 is 10-base-T,  
9 whereas the fiber communications on the fiber backbone 14 are set at 100-base-T. NAN 10  
10 communications preferably utilize the Ethernet 802.3 standard which is the standard presently  
11 relied upon by most Internet and network organizations. The Ethernet 802.3 standard is used  
12 in one embodiment of the NAN for packet encapsulation for transfer of the packets 165 over  
13 communication lines 36, 38.

14 In order for a new communicating station 30 to be admitted to communicate on the  
15 NAN 10, it must first establish communications with the server 18. The server 18, as  
16 described, maintains a binding between IP addresses and MAC addresses. The client software  
17 126 which is installed on every communicating station 30 provides the communicating station  
18 30 with the proper MAC address of the server 18. Thus the communicating station  
19 communicates with the server 18 to receive a localized non-routable IP address for use in  
20 communications external to the NAN-10.

21 In one embodiment, the communicating station 30 may be given a permanent IP  
22 address issued by Internic or may be given a non-routable address and use the masquerading  
23 procedure discussed above. Additionally, there may be several different types of IP addresses  
24 issued. As discussed, routable and non-routable IP addresses may be issued as well as filtered  
25 IP addresses that filter content received from the Internet. Additionally, an IP address may  
26

1 be partially or fully functional depending on whether the communicating station 30 has paid  
2 a monthly or yearly fee.

3 Every station 30 checks in with the server 18 at the initial login in one embodiment,  
4 but if the server 18 is not functioning, the stations 30 may still continue to operate with the  
5 previously issued IP address. E-mail messages may be sent to a permanent IP address, or may  
6 be routed in the manner of outside station 72 communications as discussed above.

7 Shown in Figure 5 are the contents of a typical home connection box 42, including  
8 a power coupler 184. The home connection box 42 may comprise a protective housing 182.  
9 Within the housing 182 is shown a power coupler adapter 184. Connected to the adapter 184  
10 is a wire 174. The wire 174 emanates from a transformer 173 which is in electrical  
11 communication with a power outlet 172. Also shown is an RF wire 176 carrying transmitted  
12 signals from the power meter 46. Of course, power consumption may also be transmitted  
13 over air waves as discussed above. The network card 156 is shown connected with the  
14 adapter 184 with the use of standard Ethernet cable 178 which is plugged into jacks 180.

15 The network card 156 is preferably a standard 10-base-T Ethernet network card. The  
16 adapter 184 also has shown connected thereto a set of wires 186. One example of a network  
17 card 156 suitable for use with the present invention comprise a standard Ethernet 10-base T  
18 network card such as the CN2000 card available from CNET of Milpitas, California.

19 A pair of first twisted pair wires 186a contains transmit information and a second set  
20 of twisted pair wires 186b contains received information. A third set of twisted pair wires  
21 186c carries AC power to the power concentrator and to a node 26. A protective conduit  
22 188 covers the wires and protects them from the elements. The protective housing 182 is  
23 preferably mounted to the outside of the home or building within which the communicating  
24 station 30 is located.

25 Shown in Figure 6 is one embodiment of the home connection box 42. Shown therein  
26 is a base 183 containing therein the adapter 187. The protective housing 182 is adapted to

1 fit over the base 183. Jacks 185 are shown for receiving the wires 178, 174, 176 of Fig. 5.  
2 The outgoing wires 186 are also shown. Wiring is preferably labeled and connected on an  
3 alphabetical basis.

4 Shown within the central headquarters 20 is a statistics checker 158 for receiving  
5 information from the semi-intelligent repeaters 24. The stats checker 158 receives the  
6 information from the repeaters 24 and determines that the repeaters 24 are online and  
7 functioning properly. A report may be generated by the statistics checker 158 and warnings  
8 may be sent to an operator in real time.

9 The hubs 26 are connected to the coaxial cable 38 with a T-connector so as not to  
10 break the connection. The hubs convert from coaxial cabling to twisted pair wires and  
11 provide collision detection as well as amplification.

12 Client software 126 provides an arrangement similar to a DHCP client, but contrary  
13 to DHCP clients of the prior art, the client software 126 does not broadcast and does not  
14 lease an IP address, but rather, contains a permanent or semi-permanent IP address. This  
15 keeps the network uncluttered. This is allowable because the DHCP client can be identified  
16 by the MAC address and routable IP addresses. Indeed, standard DHCP servers and  
17 broadcast traffic are not allowed on the network. In one embodiment, standard DHCP  
18 servers and broadcast traffic that do repeatedly transmit broadcast traffic are found and  
19 crashed or otherwise disallowed on the network.

20 The server 18 is preferably a DHCP-type server which performs management tasks  
21 including keeping track of and handing out IP addresses. The customers use a password to  
22 get their initial IP address. Once the communicating stations 30 receive their IP address 136  
23 they may talk on a TCP/IP layer. A binder utility 157 may reside within the central  
24 headquarters. The binder utility 157 in one embodiment binds the IP address with the MAC  
25 address and may be used as a guarantee of customer payment.

26



1 The DHCP server and the DHCP clients talk at the MAC layer. Under the OSI  
2 standard model, this is the first and second layer. Then once the IP address is picked up, they  
3 may communicate at different layers such as the TCP/IP layer. Hubs and repeaters preferable  
4 communicate at the MAC layer while the server 20 ensures that a machine with a given MAC  
5 address has the assigned IP address and maintains this binding.

6 Thus, by eliminating broadcast traffic and making the NAN 10 essentially a routerless  
7 network, the NAN 10 can be operated at high speeds and on large scales. Only specific types  
8 of traffic are allowed to travel the NAN, further maintaining the high speed of the NAN.  
9 Under the present invention, the NAN determines what can travel thereon, rather than what  
10 cannot travel thereon as in the prior art. Indeed, the NAN 10, including the switches, bridges  
11 and wires, operates outside of the standard "mold" of networks because its implementation  
12 does not follow IEEE or other standards.

13 The high speed of the NAN 10 of the present invention is attributable to a number of  
14 cooperating factors. For instance, rather than adhering to standard IEEE standards such as  
15 the Cat5 standard, packets are transmitted with greater power and can be transmitted up to  
16 1500 feet using a higher power level and more sensitive receiving equipment before being  
17 picked up. This provides a longer acknowledgment time, and because the packets are directly  
18 routed using the local/external method described above, the packets are on the NAN for  
19 shorter periods of time causing less collisions.

20 Hubs, similar to the bridges, also restrict local traffic and do not pass it on to the NAN  
21 10 but contain all traffic that is local to that hub. Typically, bridges may be located four  
22 repeaters from each other and may service about five hubs. Each hub may service about five  
23 communicating stations 30.

24 Each switch and bridge regenerates the packet 165, whereas the hub holds the packet  
25 in a buffer and may or may not regenerate the packet 165 depending on the level of amplitude  
26 of the packet.



1 The local partitioning and high rate of speed of the NAN 10 are enabled to a large  
2 degree by a unique firmware residing within the switching components. This unique firmware  
3 includes a tree structure sorting algorithm within the switching components. Initially, the  
4 novel firmware is much simplified in that the decisions are binary. That is, the switching  
5 components determine whether a packet is addressed local or external. Additionally, the  
6 databases are larger and hold a greater number of MAC addresses. In one embodiment  
7 greater than 800 MAC addresses are be contained within the databases 66. In a further  
8 embodiment, greater than 10,000 MAC addresses are contained, and in a further embodiment,  
9 15,000 or more MAC addresses are contained.

10 The NAN 10 keeps traffic local and partitioned and, as described, kills all broadcast  
11 traffic at the bridges. Typically, the broadcast traffic doesn't make it past the bridges to the  
12 switches, but the switches may also kill any broadcast traffic.

13 The firmware also processes packets 165 in a unique manner using a distance vector  
14 algorithm that allows the packets 165 to travel further without being regenerated. The  
15 firmware allows reduction of collision rates. Nevertheless, the packets 165 don't travel as  
16 far because they are held more localized by the bridges which have larger databases. Thus,  
17 the NAN 10 is characterized more by what cannot travel it than what can travel it.

18 Shown in Fig. 7 is an earth-based pedestal 200 of the present invention. The pedestal  
19 200 comprises a pedestal base 202 which is mounted within the earth 216 a distance of at  
20 least several inches. A cylindrical outer housing 204 is shown and is provided with site 201  
21 for air-circulation. The cylindrical outer housing 204 is inserted over the base 202 to protect  
22 a circuit board 206 housed therein. The circuit board is mounted within a Faraday shield 218  
23 which may be a partial chassis or a cage.

24 The Faraday shield 218 is connected with a post 208 and is mounted within the  
25 ground a distance of approximately 1.5 feet. The post 208 is connected with copper braid  
26 wiring 212 to a pair of steel rods 214 which are mounted about 8 inches apart and

1 approximately 3 feet in the ground. This provides adequate ground charge and lightning  
2 protection for the circuit board 206.

3 The circuit board 206 typically comprises the contents of a node 26, a repeater 24, or  
4 bridge 50. Emanating through openings 210 in the Faraday shield 218 are a pair of  
5 communications wires 215. Communications wires 215 may comprise a coaxial cable 28, a  
6 twisted pair cable 40 and/or the fiberoptic cabling 36 and are preferably routed underground.  
7 In this manner, the nodes 26, feeders 24, and/or bridges 50 may be housed outside and are  
8 protected from the elements with the use of the pedestal 200.

9 An alternate embodiment of a pedestal, shown in Fig. 8 is a hanging pedestal 220.  
10 The hanging pedestal 220 is adopted to hang from locations such as power or telephone lines  
11 or poles. The hanging pedestal 220 is shown comprising a base 222 and a lid 224. In the  
12 depicted embodiment, two hanging pedestal bases 222 and lids 224 are shown separated by  
13 a hanger mount. The hanger mount 226 as depicted is comprised of a pair of hanging  
14 brackets 228. The hanging brackets 228 comprise a pair of plates 230 which are tightened  
15 in proximal contact around a line from which hanging pedestal 220 is hung with bolts 232.  
16 The base and lid may be hooked together with plastic hinges 236 and may latch with a snap-fit  
17 type latch 234. The hanging pedestals also house an electronic circuit board therein which  
18 is accessed through a set of cables 208.

19 Additional applications of the NAN 10 include video connecting, voice, video, cable  
20 TV, etc. Real time video may be provided on-demand rather than just being started every  
21 hour. The video may be downloaded in buffered portions and cached in part or in all on a  
22 memory device at a particular communicating station 30 which ordered the video. Sporting  
23 events may be archived for later viewing, and other real time events may be provided through  
24 a window frame within a monitor or screen of the communicating station 30. Home  
25 education may be provided as may be books, such that the service provider 104 may comprise  
26 a virtual library.

1 Figure 9 is a schematic block diagram illustrating one embodiment of a general  
2 method 250 of operation of a NAN. The method 250 begins at a start step 252.  
3 Subsequently, at a step 254, a network such as a NAN system is provided. Preferably, the  
4 network is configured in the manner described above for the NAN 10. At a step 256, the  
5 network is installed. Preferably, this means that a NAN 10 of the present invention is installed  
6 as described above and as will be described below in greater detail.

7 At a step 258, communicating stations 30 are connected to the network 10.  
8 Preferably, the communicating stations comprise a plurality of businesses, organizations,  
9 and/or individuals related primarily or exclusively by residence within a common geographical  
10 location. At a step 260, installation and operation of the NAN are financed. This step will  
11 be discussed in detail below, but briefly, the installation is preferably financed, at least in part,  
12 by a utility company, and operations are preferably financed by periodic subscription fees.

13 At a step 262, the network, e.g., NAN 10, is operated. Operation of the network 10  
14 preferably takes advantage of the unique configuration of the NAN 10. For instance, power  
15 is preferably cooperatively supplied from communicating stations, messages are directly  
16 routed, and localized message traffic such as advertising and security observation is routed  
17 over the network 10.

18 At a step 264, the network 10 is administered. Preferably, the network administration  
19 is provided by a private company other than the utility company that assisted in financing the  
20 installation. Administration preferably comprises billing and such matters, and is preferably  
21 conducted on behalf of cooperative ownership and management of the network. At a step  
22 266, the method 250 ends.

23 Providing a NAN system 10 of step 254 of Figure 9 may be conducted in accordance  
24 with a method 270 of Figure 10. The method 270 begins at a step 272 and progresses to a  
25 step 274. At step 274, a backbone is provided. Preferably, the backbone comprises a fiber  
26

1 backbone 12 as described above. Thus, the backbone 12 is also preferably formed in a loop  
2 circling through a geographic area which the NAN 10 is intended to serve.

3 The method 270 may also, as depicted by a step 276, comprise utilizing protocols that  
4 are not recognized standards, and particularly, that are not IEEE standards. By dispensing  
5 with IEEE standards, greater speeds and flexibility can be achieved, as discussed above. As  
6 depicted by a step 278, the method 270 may also utilize direct routing of messages. The  
7 direct routing is preferably achieved in the manner discussed above, with switching equipment  
8 and cables branching from a central backbone 14. The network 10 is also preferably  
9 partitioned, at a step 280, preferably in the manner described above, such that any particular  
10 message goes directly to and stays within a partition 70 corresponding to a station 30 to  
11 which the message is addressed.

12 A server 282 is optional, but may provided, as indicated by a step 282. The server  
13 preferably corresponds to the server 18. Additionally, a central HQ 20 is preferably provided.  
14 One or more Internet Gateways may also be provided, as indicated by a step 284. At a step  
15 286, the method ends.

16 Installing a NAN 10 of step 256 of Figure 9 may be conducted in accordance with a  
17 method 290 of Figure 11. The method 290 begins at a start step 292. As indicated at a step  
18 294, the method 290 preferably comprises installing at least a substantial portion of the  
19 cabling 36, 38, 40 of the NAN 10 within a right of way belonging to a public utility service  
20 provider company. In one embodiment, the public utility service provider comprises a power  
21 company.

22 At a step 296, the NAN 10 is installed within a selected geographical area. Preferably,  
23 the geographical area comprises a municipality, and more preferably, a portion of a  
24 municipality, such as a neighborhood. As indicated at a step 298, switching equipment is  
25 installed. The switching equipment preferably includes the fiber switches, the repeaters, the  
26 bridges 30, and the hubs 26. In one embodiment, at least a substantial portion of the

1 switching equipment is installed out of doors, preferably within containment units 52 or  
2 protective pedestals 200, 220.

3 At a step 300, the switching equipment is preferably connected to power sources  
4 located at the communicating stations 30. Preferably, the communicating stations 30  
5 cooperatively and redundantly provide the power to switching equipment as discussed above.  
6 Thus, external power sources may not be needed, and if power goes out or is terminated at  
7 a single communicating station 30, power can be supplied by the other communicating  
8 stations 30. Preferably, the delivery of power is coordinated by a power concentrator 25.

9 At a step 302, the protective pedestals 200, 220 are preferably provided for housing  
10 the switching equipment. At a step 304, the cabling 36, 38, 40 is provided, preferably by  
11 burying the cabling within the rights of way of the utility company.

12 At a step 306, the server 18 and the central HQ computer 20 are provided. Of course,  
13 other steps will be necessary to completely install the NAN 10, but will be readily apparent  
14 to those of skill in the art from the present description. At a step 308, the method 290 ends.

15 Connecting stations of step 258 of Figure 9 may be conducted in accordance with a  
16 method 310 of Figure 12. The method 310 begins at a start step 312 and progresses to a step  
17 314. At the step 314, users subscribe to the NAN service (and) or Internet service. That is,  
18 users such as individuals at residences, businesses, schools, and other organizations at the  
19 various communicating stations 30 subscribe to receive NAN service. The subscribing is  
20 preferably conducted prior to installing the relevant switching equipment in the NAN of the  
21 subscribers.

22 At a step 316, the NAN is connected to individual residences or places of business.  
23 Unlike most limited distribution networks, the NAN 10 is preferably connected to multiple  
24 residences, businesses, and/or organizations. In installing the NAN, connections are  
25 preferably made to each building in which is housed one or more communicating stations 30.  
26



1 Preferably, in a step 318, each communicating station 30 is provided with a home connection  
2 box 42 to which the NAN cabling and switching equipment is connected.

3 At a step 320, the switching equipment local to each communicating station 30 is  
4 connected with the communicating station 30 to receive power from the communicating  
5 station 30. Thus, power delivery is shared by groups of communicating stations 30 as  
6 described above.

7 At a step 322, a plurality of communicating stations 30 are preferably placed in  
8 communication by a connection to common switching equipment such as a node or hub 26  
9 of Figure 1. Preferably, the switching equipment is located out of doors in a centralized  
10 location, and more preferably, is located within a ground-based pedestal 200 or a hanging  
11 pedestal 220.

12 As indicated by a step 324, installation of the NAN 10 preferably comprises  
13 connecting together in the NAN 10 only communicating stations 30 related by location within  
14 a common geographical area. The geographical area may be any selected area, but preferably  
15 comprises a municipality, plurality of municipalities, or portions thereof such as common  
16 neighborhoods. At a step 326, the method 310 ends.

17 Financing installation and operation of a NAN system of step 260 of Figure 9 may be  
18 conducted in accordance with a method 330 of Figure 13. The method 330 begins at a start  
19 step 332 and progresses to a step 334. At step 334, subscription fees are received from users  
20 at the communicating stations 30. Preferably, the users are subscribed prior to connecting the  
21 communicating stations 30 to the NAN. The fees are preferably paid periodically and the  
22 proceeds used to maintain and administer the NAN and recompense the providers of the NAN  
23 system 10 as well as possibly to help compensate an alliance organization such as the utility  
24 company that has assisted in financing the advertising of and installation of the NAN 10.

25 As indicated by a step 336, the NAN 10 may also be in part financed by a utility  
26 service provider company. In one embodiment, the utility service provider company is other



1 than a telecommunications company. By receiving assistance from a gas, power, water  
2 company or the like, these utility service providers that are otherwise unable to participate in  
3 the expansion of digital communications can be a part of this growth. Thus, in one example,  
4 a power company allows the NAN 10 to be installed in rights of way granted to the power  
5 company and may also in part or whole finance the installation. Solicitation of users may also  
6 be financed by an alliance organization such as a utility service provider company.

7 As indicated by a step 338, the utility service provider company or other alliance  
8 organization receives a portion of the subscription fees received in step 334 to compensate  
9 it for its costs of installation and solicitation. Additionally, the utility company is also  
10 preferably provided with use of the NAN to accomplish tasks such as reading utility meters  
11 at the communicating stations 30 and billing the communicating stations 30 for use of the  
12 utility services.

13 Additionally, as indicated by a step 342, companies making use of the NAN may be  
14 charged. For instance, content providers, Internet service providers, advertisers, and the like  
15 may be charged for their use of the NAN 10. At a step 346 the method 330 ends.

16 Operating a NAN system of step 262 of Figure 9 may be conducted in accordance  
17 with a method 350 of Figure 14. The method 262 begins at a start step 352 and progresses  
18 to a step 354. As indicated, the operation of the NAN may comprise receiving the power to  
19 operate the switching equipment cooperatively from the communicating stations 30. As  
20 indicated by a step 356, the method 362 may comprise remote reading of utility consumption  
21 as described above.

22 As indicated by step 358, the method 350 may comprise remotely billing users at  
23 communicating stations 30 for utility services. As indicated by a step 360, the method 350  
24 may comprise transmitting security signals over the NAN 10. Thus, for instance, when the  
25 communicating stations 30 are provided with security systems 46 such as cameras, sensors,  
26 or the like, monitoring of the cameras or sensors or other surveillance equipment can be

1 conducted by transmitting signals therefrom over the NAN 10 to a central surveillance office  
2 which itself comprises a communicating station 30.

3 At a step 362, audio and video signals may be transmitted over the NAN 10. Thus,  
4 for instance, music may be piped into residences or businesses over the NAN 10 and video  
5 signals such as live feeds and recordings may likewise be transmitted over the NAN 10.  
6 While the television signals may be broadcast, more preferably, the video signals are provided  
7 to requesting stations 30 on-demand. Video conferencing may likewise be provided.

8 At a step 364, broadcast data is truncated or otherwise eliminated from the NAN 10.  
9 This is preferably conducted in the manner described above.

10 At a step 366, messages are directly routed from sender to receiver over the NAN.  
11 Once again, this is preferably conducted in the manner described above.

12 At a step 368, routing of messages utilizes partitions of the NAN. In preferred  
13 embodiments, the partitioning is conducted as described above.

14 At a step 370, a plurality of Internet gateways are provided for connecting the NAN  
15 with Internet service. While a single Internet gateway may be provided, it is preferred that  
16 several are provided to promote competition and lower prices.

17 At a step 372, localized advertising is transmitted over the NAN. Thus, for instance,  
18 a communicating station 30 may comprise a local business within the geographical area which  
19 the NAN encompasses, and may wish to transmit advertising to other communicating stations  
20 30. Such advertising may be accomplished by directing advertising directly to selected  
21 communicating stations 30, which are more likely to be interested in the advertising due to  
22 the close proximal location of the advertising business. Of course, the discussed steps of the  
23 method 350 are given by way of example, and many other manners of operating a NAN of  
24 the present invention will be readily apparent to those of skill in the art. At a step 374, the  
25 method 350 ends.

26

1 Administering a NAN of step 264 of Figure 9 may be conducted in accordance with  
2 a method 380 of Figure 15. The method 380 begins at a start step 382 and progresses to a  
3 step 384. At step 384, periodic billing statements may be transmitted over the NAN 10. The  
4 billing is preferably coordinated and monitored by the central HQ 20.

5 At a step 386, payments may also be transmitted over the NAN by credit card, digital  
6 signature types of E-commerce, and the like. When a communicating station 30 fails to pay  
7 its bills, reminders may be automatically sent over the NAN, and if the problem persists,  
8 suspension of NAN privileges may be levied until the fees are paid as indicated by a step 388.

9 As indicated by a step 390, administration may be conducted by government entities  
10 such as municipalities, but more preferably, the administrative entity comprises a private  
11 organization. The organization may be the provider of the NAN. Preferably, where a utility  
12 service provider is involved in financing and installing the NAN 10, the administrative entity  
13 is other than the utility service provider. In one embodiment, as represented by a step 392,  
14 the ownership and management of the NAN 10 is a cooperative venture of the users located  
15 at the various communicating stations 30. The method 380 preferably ends at a step 394.

16 The NAN of the present invention provides certain advantages including providing  
17 high speed (high band width) Internet access at a low price compared to conventional  
18 technologies. Advantages of the NAN also include the capability of real-time video  
19 conferencing. The NAN allows a region such as a geographical region of otherwise unrelated  
20 entities, such as a town or neighborhood, to be networked in high speed computer  
21 communication.

22 The NAN may be financed at least partially by utilities in order to expedite installation  
23 and may rely on the rights of way of public utilities such as power companies. The "last mile"  
24 dilemma is also solved under the present invention, as the system allows for inexpensive  
25 installation of facilities for the "last mile" of a network infrastructure and relatively faster  
26

1 operation thereof. Thus, an advantage of the NAN is that it provides cost effective last mile  
2 service and delivery.

3 The NAN also operates at very high speeds. Preferably, message traffic is directly  
4 hauled to its destination, rather than passing the message traffic through a central server or  
5 router. Indeed, under one embodiment, the NAN efficiencies are achieved without a central  
6 server altogether.

7 Additionally, the NAN provides support for a broader variety of devices and types of  
8 devices to be networked. The NAN system of the present invention does not rely on the  
9 telephone line infrastructure, and consequently eliminates handling errors that occur with user  
10 log ons. Additionally, the telephone lines and other telecommunications infrastructure receive  
11 less traffic and are less likely to be jammed with message traffic when the NAN is employed  
12 to relieve them of being overburdened. Indeed, the NAN in one embodiment achieves total  
13 independence from the telecommunication infrastructure.

14 Also, no modem hardware or protocol is necessary at the user facility. Conventional  
15 T-1 lines, fiber converters, and cable modems are unnecessary in achieving the much higher  
16 speeds of the NAN of the present invention. Additionally, Internet access may be provided  
17 over the NAN and Internet connection may operate at comparatively high speeds. For  
18 instance, Internet access may in one example be as high as ten Mbps while employing certain  
19 currently available hardware.

20 The NAN allows free competition among Internet service providers and allows them  
21 to freely hook into the NAN system. The Internet connectivity is always on and continuous  
22 at any given communicating station without the need of a dial-up. Due to the elimination of  
23 modems in connecting to the Internet, low data losses are experienced. For instance, hand  
24 shaking errors between modems and error data that otherwise arises between modems may  
25 be reduced or eliminated. This is largely due to the absence of protocol conversions with the  
26 inventive system.

1 The operational hardware and software of the NAN include hubs, packets, bridges,  
2 and gateways disposed at different points to allow directly routed, packeted traffic. The  
3 system distributes traffic to the lowest segment. Direct routing may be peer-to-peer rather  
4 than being controlled by a switchboard, server, or central office. The results of this  
5 arrangement is very high speed packet transfer.

6 The system may rely on MAC addresses and static, masqueraded, IP addressing rather  
7 than dynamic IP addressing. The system may provide a binding between a hardware device  
8 and a user so the system stores the user's public IP addresses.

9 Additionally, communications within the network are secure and the network is user  
10 friendly. The high-speed networking supports real-time communications with cameras.  
11 Indeed, because of the low cost, users can connect to more devices, one example of which  
12 is utility meters. The system makes remote meter reading and monitoring of other types of  
13 utility services cost effective.

14 The NAN of the present invention is also unique in that no network administration is  
15 necessary to control local message traffic. Traffic may be independent of any governing  
16 authority. Additionally, because the Internet is both a large scale system and localized within  
17 a geographic area, business services such as advertising can be offered locally, making them  
18 more efficient. Thus, local advertising may be directed to a local audience. The system may  
19 support interconnection with virtually any devices within a community. The system may  
20 utilize permanent IP addresses due to a unique Dynamic Host Configuration Protocol  
21 (DHCP).

22 The neighborhood area network (NAN) may operate upon an IPX/SPX and Ethernet  
23 protocol. Broadcasts packets from the clients are preferably blocked at every bridge as well  
24 as DHCP traffic.

25 The present invention may be embodied in other specific forms without departing from  
26 its spirit or essential characteristics. The described embodiments are to be considered in all

1 respects only as illustrative and not restrictive. The scope of the invention is, therefore,  
2 indicated by the appended claims rather than by the foregoing description. All changes which  
3 come within the meaning and range of equivalency of the claims are to be embraced within  
4 their scope.

5 What is claimed and desired to be secured by United States Letters Patent is:

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